range by considering their effect on emission levels, as well as how likely it is someone will make such an adjustment with in-use vehicles.

(3) We may adjust the air-fuel ratio within the adjustable range specified in § 1051.115(d).

(e) *Stabilizing emission levels.* Before you test production-line vehicles or engines, you may operate the vehicle or engine to stabilize the emission levels. Using good engineering judgment, operate your vehicles or engines in a way that represents the way they will be used. You may operate each vehicle or engine for no more than the greater of two periods:

(1) 50 hours or 500 kilometers.

(2) The number of hours or kilometers you operated the emission-data vehicle used for certifying the engine family (see 40 CFR part 1065, subpart E, or the applicable regulations governing how you should prepare your test vehicle or engine).

(f) *Damage during shipment.* If shipping a vehicle or engine to a remote facility for production-line testing makes necessary an adjustment or repair, you must wait until after the initial emission test to do this work. We may waive this requirement if the test would be impossible or unsafe, or if it would permanently damage the vehicle or engine. Report to us, in your written report under § 1051.345, all adjustments or repairs you make on test vehicles or engines before each test.

(g) *Retesting after invalid tests.* You may retest a vehicle or engine if you determine an emission test is invalid under subpart F of this part. Explain in your written report reasons for invalidating any test and the emission results from all tests. If you retest a vehicle or engine, you may ask us within ten days of testing. We will generally answer within ten days after we receive your information.

[67 FR 68347, Nov. 8, 2002, as amended at 70 FR 40498, July 13, 2005]

§ 1051.310 How must I select vehicles or engines for production-line testing?

(a) Use test results from two vehicles or engines for each engine family to calculate the required sample size for the test period. Update this calculation with each test.

(1) For engine families with projected annual sales of at least 1600, the test periods are consecutive quarters (3 months). If your annual production period is less than 12 months long, define your test periods by dividing your annual production period into approximately equal segments of 70 to 125 calendar days.

(2) For engine families with projected annual sales below 1600, the test period is the whole model year.

(b) Early in each test period, randomly select and test an engine from the end of the assembly line for each engine family.

(1) In the first test period for newly certified engines, randomly select and test one more engine. Then, calculate the required sample size for the test period as described in paragraph (c) of this section.

(2) In later test periods or for engine families relying on previously submitted test data, combine the new test result with the last test result from the previous test period. Then, calculate the required sample size for the new test period as described in paragraph (c) of this section.

(c) Calculate the required sample size for each engine family. Separately calculate this figure for HC, NO_X (or $HC+NO_X$), and CO (and other regulated pollutants). The required sample size is the greater of these calculated values. Use the following equation:

$$N = \left[\frac{(t_{95} \times \sigma)}{(x - STD)} \right]^2 + 1$$

Where:

N = Required sample size for the model year.

t_{95} = 95% confidence coefficient, which depends on the number of tests completed, n, as specified in the table in paragraph (c)(1) of this section. It defines 95% confidence intervals for a one-tail distribution.

x = Mean of emission test results of the sample.

STD = Emission standard (or family emission limit, if applicable).

σ = Test sample standard deviation (see paragraph (c)(2) of this section).

n = The number of tests completed in an engine family.

(1) Determine the 95% confidence coefficient, t_{95}, from the following table:

n	t_{95}	n	t_{95}	n	t_{95}
2	6.31	12	1.80	22	1.72
3	2.92	13	1.78	23	1.72
4	2.35	14	1.77	24	1.71
5	2.13	15	1.76	25	1.71
6	2.02	16	1.75	26	1.71
7	1.94	17	1.75	27	1.71
8	1.90	18	1.74	28	1.70
9	1.86	19	1.73	29	1.70
10	1.83	20	1.73	30+	1.70
11	1.81	21	1.72	....	....

(2) Calculate the standard deviation, σ, or the test sample using the following formula:

$$\sigma = \sqrt{\frac{\sum (X_i - x)^2}{n-1}}$$

Where:

X_i = Emission test result for an individual vehicle or engine.

(d) Use final deteriorated test results to calculate the variables in the equations in paragraph (c) of this section (see § 1051.315(a)).

(e) After each new test, recalculate the required sample size using the updated mean values, standard deviations, and the appropriate 95-percent confidence coefficient.

(f) Distribute the remaining vehicle or engine tests evenly throughout the rest of the year. You may need to adjust your schedule for selecting vehicles or engines if the required sample size changes. Continue to randomly select vehicles or engines from each engine family.

(g) Continue testing any engine family for which the sample mean, x, is greater than the emission standard. This applies if the sample mean for either HC, NO_X (or HC+NO_X) or CO (or other regulated pollutants) is greater than the emission standard. Continue testing until one of the following things happens:

(1) The number of tests completed in an engine family, n, is greater than the required sample size, N, and the sample mean, x, is less than or equal to the emission standard. For example, If N = 3.1 after the third test, the sample-size calculation does not allow you to stop testing.

(2) The engine family does not comply according to § 1051.315.

(3) You test 30 vehicles or engines from the engine family.

(4) You test one percent of your projected annual U.S.-directed production volume for the engine family, rounded to the nearest whole number.

(5) You choose to declare that the engine family fails the requirements of this subpart.

(h) If the sample-size calculation allows you to stop testing for a pollutant, you must continue measuring emission levels of that pollutant for any additional tests required under this section. However, you need not continue making the calculations specified in this section for that pollutant. This paragraph does not affect the requirements in section § 1051.320.

(i) You may elect to test more randomly chosen vehicles or engines than we require under this section. Include these vehicles or engines in the sample-size calculations.

[67 FR 68347, Nov. 8, 2002, as amended at 70 FR 40498, July 13, 2005]

§ 1051.315 How do I know when my engine family fails the production-line testing requirements?

This section describes the pass-fail criteria for the production-line testing requirements. We apply these criteria on an engine family basis. See § 1051.320 for the requirements that apply to individual vehicles or engines that fail a production-line test.

(1) *Initial and final test results.* Calculate and round the test results for each vehicle or engine. If you do several tests on a vehicle or engine, calculate the initial test results, then add them together and divide by the number of tests and round for the final test results on that vehicle or engine.

(2) *Final deteriorated test results.* Apply the deterioration factor for the engine family to the final test results (see § 1051.240(c)).

(b) Construct the following CumSum Equation for each engine family for HC, NO_X (or HC+NO_X), and CO emissions (and other regulated pollutants):

$$C_i = C_{i-1} + X_i - (STD + 0.25 \times \sigma)$$

Where:

C_i = The current CumSum statistic.
C_{i-1} = The previous CumSum statistic. For the first test, the CumSum statistic is 0 (*i.e.* $C_1 = 0$).